1. The virtual refraction

In seismic data applications of Seismic Interception (Figure 4 and 5), an artificial reflector has been created as the original data contain hard waves (Mikese et al., 2009). This synthetic event is called the virtual reflection. In this case of horizontal layers, the movement of the virtual reflection does not affect the ray path (3).

2. Delay-time statics

Small traveltime perturbations (i.e., statics due to near-surface heterogeneity) determine reflection seismic images. Figure 6 depicts an example of a surface wave where curve thickness is the thickness of the layer. A variety of methods exist for correcting this type of near-surface heterogeneity. For example, if the velocity at different layers is known, static correction can be computed and the recorded wavelet can be corrected.

3. Modified statics with the virtual refraction

Consider two receivers at $R_1$ and $R_2$ and $s_1$ and $s_2$ respectively. The seismic wave arrives at both receivers simultaneously, and the recorded wavelet can be corrected.

$T_{R1} - T_{R2} = \Delta t = \frac{s_1 - s_2}{v}$

The post-stack reflection is the virtual reflection plus the recorded traveltime difference, $\Delta t$ in the reference receiver $R_2$ to the reference receiver $R_1$. The combination of the two equations in Figure 7 represents the virtual refraction.

We estimate the receiver statics for each source at $R_1$ in the forward direction and for each receiver at $R_2$ in the reverse direction. The first arrival of $s_1$, the second arrival of $s_2$, and the virtual reflection first break times.

4. Scanning for regional heterogeneity

The following example shows how we estimate trend anomalies within the crust and mantle. We use the $T_{R1}$ anomalies to estimate shallow heterogeneity within the Earth. The depth of the raypaths of the shot path and the virtual raypaths of the virtual raypaths is determined. The second arrival of $s_2$, and the virtual reflection first break times.

5. Conclusion

We estimate the receiver statics by using a modified delay-time inversion based on the virtual refraction, which increases the lateral resolution. We can distinguish CMB reflections and $P_{n}$ reflections to indicate receiver-static heterogeneity within the crust and mantle.

The next step is to determine the movements of the Earth's crust in relation to the global tectonic activity. In the future, we will focus on further developments of the virtual refraction method to improve the accuracy of the results.